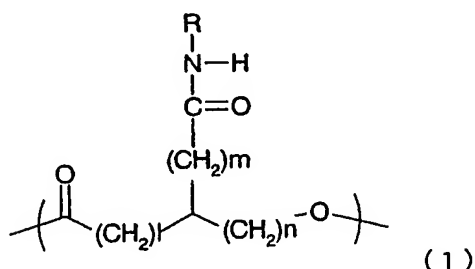


## CLAIMS

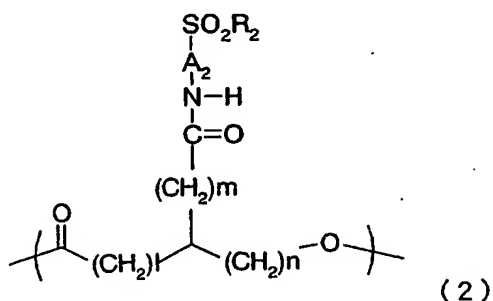
1. A polyhydroxyalkanoate characterized in that the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (1) in a molecule:



wherein R represents  $-\text{A}_1-\text{SO}_2\text{R}_1$ ;  $\text{R}_1$  is selected from the group consisting of OH, a halogen atom, ONa, OK and  $\text{OR}_{1a}$ ;  $\text{R}_{1a}$  and  $\text{A}_1$  independently represent a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure or a substituted or unsubstituted heterocyclic structure, respectively;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present, R,  $\text{R}_1$ ,  $\text{R}_{1a}$ ,  $\text{A}_1$ ,  $l$ ,  $m$  and  $n$  mean as above independently for every unit.

2. The polyhydroxyalkanoate according to claim 1 characterized in that the polyhydroxyalkanoate comprises one or more units selected from those

represented by the chemical formula (2), the chemical formula (3), the chemical formula (4A) or the chemical formula (4B) in a molecule as a unit of chemical formula (1)

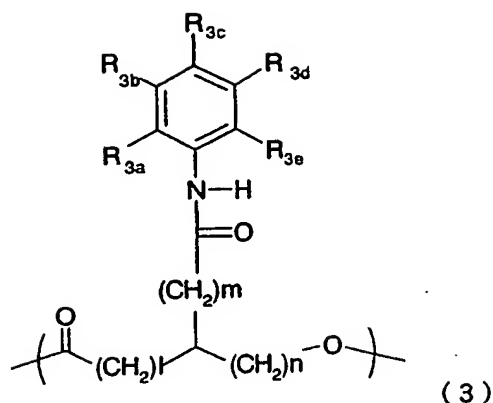


5

wherein  $\text{R}_2$  is selected from the group consisting of OH, a halogen atom, ONa, OK and  $\text{OR}_{2a}$ ;  $\text{R}_{2a}$  is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group;  $\text{A}_2$

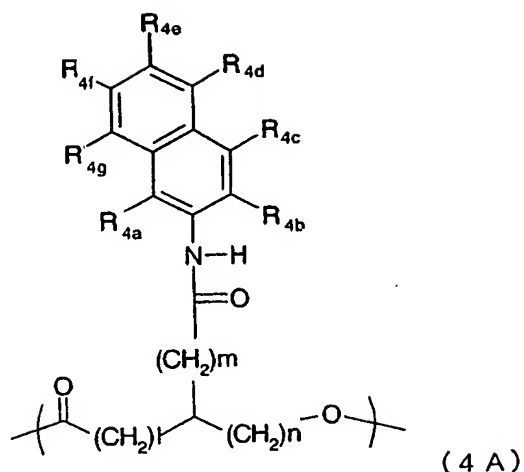
10 represents a linear or branched alkylene group having 1 to 8 carbon atoms;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4 and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  $\text{A}_2$ ,  $\text{R}_2$ ,  $\text{R}_{2a}$ ,  $l$ ,  $m$  and  $n$  mean as

15 above independently for every unit.



wherein  $R_{3a}$ ,  $R_{3b}$ ,  $R_{3c}$ ,  $R_{3d}$  and  $R_{3e}$  are independently  $SO_2R_{3f}$  wherein  $R_{3f}$  is selected from the group consisting of OH, a halogen atom, ONa, OK and  $OR_{3f1}$ ,  
 5 wherein  $OR_{3f1}$  is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms,  
 10 OH group,  $NH_2$  group,  $NO_2$  group,  $COOR_{3g}$  group, wherein  $R_{3g}$  represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NHPPh group,  $CF_3$  group,  $C_2F_5$  group or  $C_3F_7$  group, wherein Ph represents a phenyl group, respectively, and at least one of these  
 15 groups is  $SO_2R_{3f}$ ;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  $R_{3a}$ ,  $R_{3b}$ ,  $R_{3c}$ ,  $R_{3d}$ ,  $R_{3e}$ ,  $R_{3f}$ ,  $R_{3f1}$ ,  $R_{3g}$ , and  $l$ ,  $m$  and  $n$  mean as above independently for every  
 20 unit

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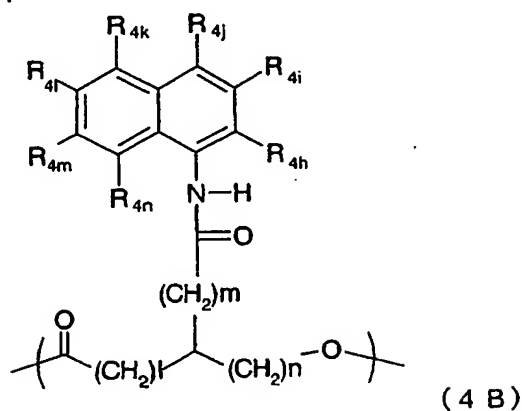
wherein  $R_{4a}$ ,  $R_{4b}$ ,  $R_{4c}$ ,  $R_{4d}$ ,  $R_{4e}$ ,  $R_{4f}$  and  $R_{4g}$  are independently  $SO_2R_{4o}$ , wherein  $R_{4o}$  is selected from the group consisting of OH, a halogen atom, ONa, OK and

5  $OR_{4o1}$ , wherein  $OR_{4o1}$  is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms,

10 OH group,  $NH_2$  group,  $NO_2$  group,  $COOR_{4p}$  group, wherein  $R_{4p}$  represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NPh group,  $CF_3$  group,  $C_2F_5$  group or  $C_3F_7$  group, wherein Ph represents a phenyl group, respectively, and at least one of these

15 groups is  $SO_2R_{4o}$ ;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  $R_{4a}$ ,  $R_{4b}$ ,  $R_{4c}$ ,  $R_{4d}$ ,  $R_{4e}$ ,  $R_{4f}$ ,  $R_{4g}$ ,  $R_{4o}$ ,

$R_{4o1}$ ,  $R_{4p}$ , and  $l$ ,  $m$  and  $n$  mean as above independently for every unit



wherein  $R_{4h}$ ,  $R_{4i}$ ,  $R_{4j}$ ,  $R_{4k}$ ,  $R_{4l}$ ,  $R_{4m}$  and  $R_{4n}$  are

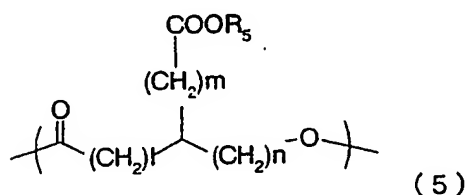
5 independently  $SO_2R_{4o}$ , wherein  $R_{4o}$  is selected from the group consisting of OH, a halogen atom, ONa, OK and  $OR_{4o1}$ , wherein  $OR_{4o1}$  is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a

10 halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, OH group,  $NH_2$  group,  $NO_2$  group,  $COOR_{4p}$  group, wherein  $R_{4p}$  represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NHPH group,  $CF_3$  group,

15  $C_2F_5$  group or  $C_3F_7$  group, wherein Ph represents a phenyl group, respectively, and at least one of these groups is  $SO_2R_{4o}$ ;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more

units are present,  $R_{4h}$ ,  $R_{4i}$ ,  $R_{4j}$ ,  $R_{4k}$ ,  $R_{4l}$ ,  $R_{4m}$ ,  $R_{4n}$ ,  $R_{4o}$ ,  $R_{4ol}$ ,  $R_{4p}$ , and  $l$ ,  $m$  and  $n$  mean as above independently for every unit.

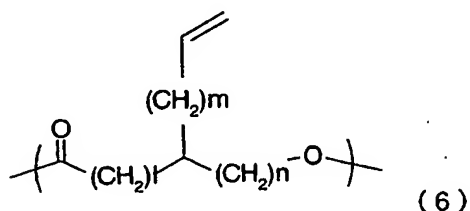
3. A polyhydroxyalkanoate characterized in that  
 5 the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (5) in a molecule:



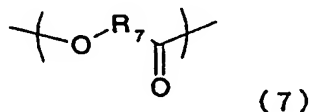
wherein  $R_5$  is hydrogen, a salt forming group or  $R_{5a}$ ;  
 10  $R_{5a}$  is a linear or branched alkyl group having 1 to 12 carbon atoms, an aralkyl group or a substituent having a saccharide;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4,  $m$  is an integer selected from 0 to 8; and when  $l$  is 1, 3 and  
 15 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when  $l$  is 2 and  $n$  is 1, 3 and 4,  $m$  is an integer selected from 0 to 8; and when  $l$  is 2 and  $n$  is 2,  $m$  is an integer selected from 1 to 8; and when  $l$  is 2,  $n$  is 2 and  $m$  is 0,  $R_{5a}$   
 20 is a substituent having a saccharide; and when two or more units are present,  $R_5$ ,  $R_{5a}$ , and  $l$ ,  $m$  and  $n$  mean as above independently for every unit.

4. A polyhydroxyalkanoate characterized in that

the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (6) in a molecule:



- 5 wherein  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  $l$ ,  $m$ , and  $n$  mean as above independently for every unit.
- 10 5. The polyhydroxyalkanoate according to any one of claims 1 to 4 characterized in that the polyhydroxyalkanoate further comprises one or more units represented by the chemical formula (7) in a molecule:

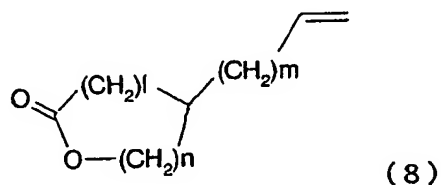


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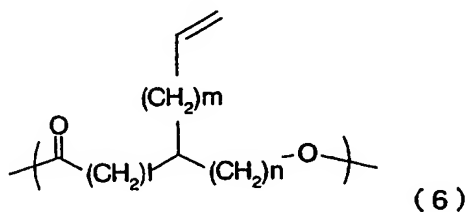
- wherein  $R_7$  is a linear or branched alkylene group having 1 to 11 carbon atoms, an alkyleneoxyalkylene group, wherein each alkylene group is independently an alkylene group having 1 to 2 carbon atoms,
- 20 respectively or an alkylidene group having 1 to 5

carbon atoms which may be substituted with aryl; and when two or more units are present,  $R_7$  means as above independently for every unit.

6. A production method of polyhydroxyalkanoate  
 5 represented by the chemical formula (6) characterized in that the method comprises a step of polymerizing a compound represented by the chemical formula (8) in the presence of a catalyst



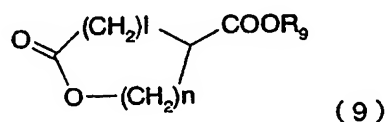
10 wherein  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8



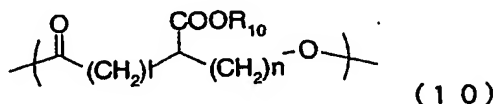
15 wherein  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  $l$ ,  $m$  and  $n$  mean as above independently for every unit.



7. A production method of polyhydroxyalkanoate represented by the chemical formula (10) characterized in that the method comprises a step of polymerizing a compound represented by the chemical formula (9) in the presence of a catalyst



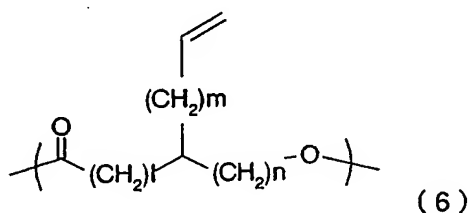
wherein  $R_9$  is a substituent selected from a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 1, 3 or 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 2,  $n$  is 1, 3 or 4



wherein  $R_{10}$  is a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 1, 3 or 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 2,  $n$  is 1, 3 or 4; and when two or more units are present,  $l$ ,  $n$  and  $R_{10}$  mean as above independently for every unit.

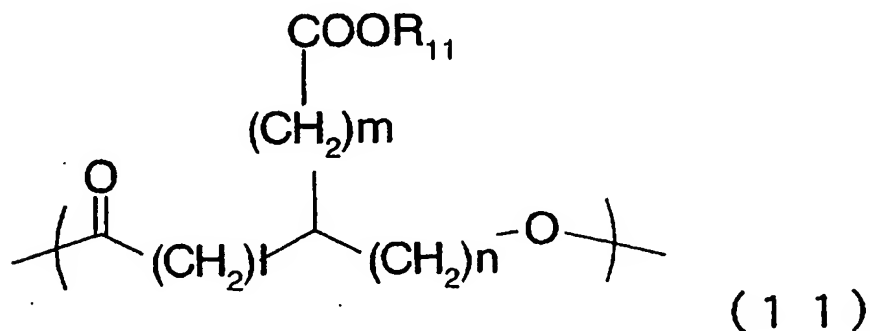
8. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (11) characterized in that the method comprises a step of oxidizing a double bond portion of

5 polyhydroxyalkanoate containing a unit represented by the chemical formula (6):



wherein  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are

10 present,  $l$ ,  $m$  and  $n$  mean as above independently for every unit

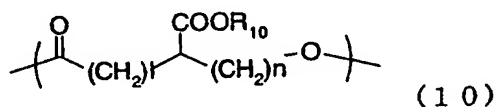


wherein  $R_{11}$  is hydrogen or a salt forming group;  $l$  is

15 an integer selected from 1 to 4,  $n$  is an integer

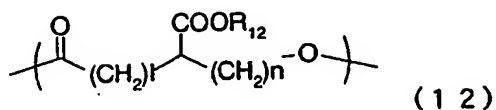
selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, l, m, n and R<sub>11</sub> mean as above independently for every unit.

- 5           9. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (12) characterized in that the method comprises a step of hydrolyzing a polyhydroxyalkanoate containing a unit represented by the chemical formula (10) in  
10 the presence of acid or alkali, or subjecting a polyhydroxyalkanoate containing a unit represented by the chemical formula (10) to hydrocracking including catalytic reduction:



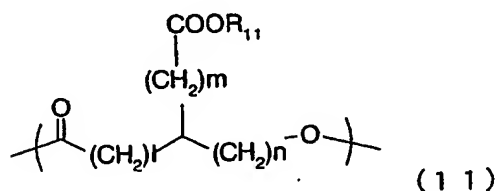
- 15 wherein R<sub>10</sub> is a substituent selected from a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and when l is 1, 3 or 4, n is an integer selected from 1 to 4,  
20 and when l is 2, n is 1, 3 or 4; and when two or more units are present, l, n and R<sub>10</sub> mean as above independently for every unit

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wherein  $R_{12}$  is hydrogen or a salt forming group;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 1, 3, and 4,  $n$  is an integer selected from 1 to 4, and when  $l$  is 2,  $n$  is 1, 3, and 4; and when two or more units are present,  $l$ ,  $n$  and  $R_{12}$  mean as above independently for every unit.

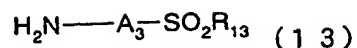
10. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (1) characterized in that the method comprises a step of subjecting a polyhydroxyalkanoate containing a unit represented by the chemical formula (11) and at least one amine compound represented by the chemical formula (13) to condensation reaction:



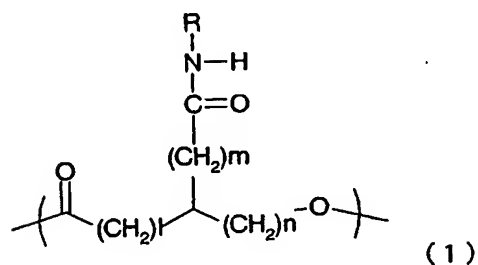
wherein  $R_{11}$  is hydrogen or a salt forming group;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,

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l, m, n and  $R_{11}$  mean as above independently for every unit



wherein  $R_{13}$  is selected from the group consisting of  
 5 OH, a halogen atom, ONa, OK and  $OR_{13a}$ ;  $R_{13a}$  and  $A_3$  are  
 independently selected from a group having a  
 substituted or unsubstituted aliphatic hydrocarbon  
 structure, a substituted or unsubstituted aromatic  
 ring structure or a substituted or unsubstituted  
 10 heterocyclic structure, respectively; and when two or  
 more units are present,  $R_{13}$ ,  $R_{13a}$  and  $A_3$  mean as above  
 independently for every unit



wherein R represents  $-A_1-SO_2R_1$ ;  $R_1$  is selected from  
 15 the group consisting of OH, a halogen atom, ONa, OK  
 and  $OR_{1a}$ ;  $R_{1a}$  and  $A_1$  independently represent a group  
 having a substituted or unsubstituted aliphatic  
 hydrocarbon structure, a substituted or unsubstituted  
 aromatic ring structure or a substituted or

unsubstituted heterocyclic structure, respectively;  $l$  is an integer selected from 1 to 4,  $n$  is an integer selected from 1 to 4, and  $m$  is an integer selected from 0 to 8; and when two or more units are present,  
5  $R$ ,  $R_1$ ,  $R_{1a}$ ,  $A_1$ , and  $l$ ,  $m$  and  $n$  mean as above independently for every unit.